

CLAIMS

What Is Claimed Is:

- 1 ~~SUB-A~~ 1. A video compression method for maximizing a throughput of  
2 digitized video data on a link between a digital solid-state imaging device and a  
3 host computer, comprising the steps of:  
4 performing the luminance (Y) domain compression of the video data on a  
5 line-by-line basis without storing video data lines or video data frames; and  
6 performing the chrominance (Cr/Cb) domain averaging of the video data  
7 on a region-by-region basis without storing video data frames,  
8 wherein said Y and Cr/Cb domain compression steps are implemented in  
9 the digital solid-state imaging device hardware for real time link transmission of  
10 the compressed video data to the host computer.
- 1 2. The video compression method of claim 1 wherein the link is a  
2 bandwidth-limited USB bus, and the digital solid-state imaging device is an USB-  
3 based camera which comprises a pixel processing controller with a low gate count,  
4 and is adapted to be small, inexpensive, and capable of transferring 30 video  
5 frames per second.
- 1 3. The video compression method of claim 1 wherein the step of the Y  
2 domain compression comprises the following steps:  
3 determining a value of a threshold for detecting a change in the luminance  
4 value between pixels in a video line;  
5 tagging pixels in the video line on a pixel-by-pixel basis, according to  
6 differences in their luminance values, said tagging step comprising the following  
7 steps:  
8 calculating the absolute value of a difference between an incoming  
9 pixel luminance value and a previously tagged pixel luminance value, and

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6 averaging the intermediate average Cb values to obtain a single average  
7 Cb value.

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compressed data with  
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3 encoding the compressed data with a minimum number of bits; and  
4 concatenating the bits of the codes representing the compressed data,  
5 wherein said concatenation is performed separately in the Y domain and in the  
6 Cr/Cb domain, and the encoding and concatenating steps are performed before  
7 the transmission to the host computer.

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10 if the absolute value of the difference exceeds the threshold value,  
11 saving the incoming pixel luminance value as a new tagged pixel luminance  
12 value and the number of pixels since the previously tagged pixel as a  
13 length; and  
14 transmitting the new tagged pixel luminance value and length to the  
15 host computer.

1 4. The video compression method of claim 1 further comprising a step  
2 of transforming the Cr/Cb data to YCbCr 4:2:0 or 4:2:2 format, said step adapted  
3 to be performed before the Cr/Cb domain compression step.

1 5. The video compression method of claim 1 wherein the step of the  
2 Cr/Cb domain compression comprises the following steps:  
3 calculating a single average value for a plurality of Cr locations;  
4 calculating a single average value for a plurality of Cb locations; and  
5 transmitting the average Cr and Cb values to the host computer.

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SUB 6. The video compression method of claim 5 wherein the step of  
2 calculating the single average value for the plurality of Cr locations comprises the  
3 step of obtaining a single Cr value for each four Cr values in the 4:2:0 format, and  
4 obtaining a single Cr value for each eight Cr values in the 4:2:2 format.

1 7. The video compression method of claim 5 wherein the step of  
2 calculating the single average value for the plurality of Cb locations comprises  
3 the step of obtaining a single Cb value for each sixteen Cb values in the 4:2:0  
4 format, and obtaining a single Cb value for each thirty-two Cb values in the 4:2:2  
5 format.

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1 12. In a digital video imaging device which works in the YCbCr 4:2:0 or  
2 4:2:2 format and is attached to a host computer via a link, a pixel processing  
3 controller comprising:

4 a Y domain compression module for tagging pixel locations in the Y domain  
5 according to a predetermined criteria;

6 a Cr/Cb domain compression module for averaging the Cr and the Cb  
7 values in the Cr/Cb domain;

8 in the Y domain a predetermined threshold value for detecting a change in  
9 the luminance value between pixels in a video line; and

10 in the Y domain a predetermined value for maximum number of pixels  
11 allowed between the tagged pixels.

1 13. The controller of claim 12 wherein the link is a bandwidth-limited  
2 USB bus, the digital video imaging device is a solid-state USB-based camera, and  
3 the pixel processing controller has a low gate count, and is adapted to be small,  
4 inexpensive and capable of transferring 30 video frames per second.

1 14. The controller of claim 12 wherein the link is a bandwidth-limited bus  
2 with isochronous pipes, the digital video imaging device is a solid-state camera  
3 working in isochronous traffic mode, and each bus pipe transmits one domain per  
4 pipe.

1 15. The controller of claim 12 wherein the predetermined threshold value  
2 and the predetermined value for maximum number of pixels allowed between the  
3 tagged pixels are supplied by the host computer.

1 16. The controller of claim 12 wherein:  
2 the Y domain compression module is adapted to determine pixels in a video  
3 line which should be tagged on a pixel-by-pixel basis, according to the  
4 predetermined criteria based on the differences in pixel luminance values; and

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1 17. The controller of claim 12 wherein the Cr/Cb domain compression  
2 module is adapted to calculate a single average value for a plurality of Cr locations  
3 and a single average value for a plurality of Cb locations, the compressed data are  
4 encoded with a minimum number of bits, and the bits of the codes representing the  
5 compressed data are concatenated separately in the Y domain and in the Cr/Cb  
6 domain, before the transmission to the host computer.

1        19. A digital imaging device attached to a host computer via a link,  
2        comprising:

5 a pixel processing controller having:

8           a Cr/Cb domain compression module for averaging the Cr and the  
9           Cb values in the Cr/Cb domain.

1        20. The digital imaging device of claim 19 wherein said link is a  
2 bandwidth-limited bus with isochronous pipes, wherein a first bus pipe transmits  
3 the Y domain values and a second bus pipe transmits the Cr/Cb domain values,  
4 and the digital imaging device is a solid-state camera working in isochronous traffic  
5 mode in the YCbCr 4:2:0 or 4:2:2 format.

1        21. The digital imaging device of claim 20 wherein:  
2 the Y domain compression module is adapted to determine pixels in the  
3 video line which are tagged on a pixel-by-pixel basis, according to differences in  
4 the pixel luminance values;

5 the camera transmits to the host computer the tagged pixel luminance  
6 values and lengths between the tagged pixels; and

7 the Cr/Cb domain compression module is adapted to calculate a single  
8 average value for a plurality of Cr locations, and a single average value for a  
9 plurality of Cb locations.

SUB 3 22. The digital imaging device of claim 21 wherein:

2 the Cr/Cb domain compression module is adapted to obtain a single Cr  
3 value for each four Cr values, and a single Cb value for each sixteen Cb values  
4 in the 4:2:0 format, and a single Cr value for each eight Cr values, and a single  
5 Cb value for each thirty-two Cb values in the 4:2:2 format;

6 said compressed data are encoded and codes are concatenated  
7 separately in the Y domain and in the Cr/Cb domain, before the transmission to  
8 the host computer; and

9 said concatenation in the Cr/Cb domain produces alternative Cr-only lines  
10 and Cr/Cb lines, where each Cr-only line has only Cr values, and each Cr/Cb line  
11 has alternating Cr and Cb values.

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